Compilation and Analysis of Climate Data in the Greater Yellowstone Ecosystem/Bighorn Canyon Area: Completed Products, Problems Encountered, and Recommendations for the Future

Final Report to the Greater Yellowstone/Bighorn Canyon Vital Signs Network

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Description of Products

The recently completed products consisted of a compilation and preliminary analysis of climate and snowpack data for the Greater Yellowstone Ecosystem and Bighorn Canyon area. The first of the three products provided a list of known climate stations in the region of interest, along with associated information such as station type, types of data available, and period of record. The second product consisted of a compilation of available data from the stations listed in the first product. The third product offered a preliminary analysis of some of the data from the second product, including temperature and precipitation surfaces, as well as a look at the historical development of the climate reporting infrastructure in the region.

Problems and Recommended Solutions

One problem identified was the absence of data prior to 1950 at some CLIM (NWS cooperative) stations where measurements were collected prior to 1950. Datasets for this project were obtained primarily from the Natural Resources Conservation Service database. Although the NRCS datasets do contain data in the early part of the century for numerous stations, data from the early years at some stations is not included. Data was obtained from NRCS primarily due to existing connections between NRCS, USGS, and NPS, as well as NRCS' willingness to provide data to cooperating federal and university researchers. In the future, the Vital Signs network may wish to acquire data from the National Climatic Data Center (http://www.ncdc.noaa.gov/oa/ncdc.html), which appears to offer more complete datasets for some stations. Obtaining daily climate data from NCDC can be expensive, and federal agencies are apparently no longer exempted from

paying for these data. In the past, NCDC has offered data free to university affiliates, and this may still be the case.

Another potential problem identified during the compilation and analysis process was the tendency for many weather stations to have been moved one or more times during their period of record. There is some evidence indicating that station moves (and associated name changes) may have been responsible for the missing data discussed in the above paragraph. More importantly, however, any climate data analysis that fails to account for station moves may lead researchers or land managers to make false conclusions about area climate. Station moves can effectively mask patterns and trends in the data or even present the illusion of patterns or trends that do not exist. Many station moves may have little or no effect on measurements, but some moves (including moves over short distances) can have a significant effect on measurements. NCDC does have information regarding station moves, but it is unlikely that each station move at every station is documented, particularly for the early part of the 20th century. A related problem is the effect that landscape changes at or near a site can have on weather observations. Changes in forest cover at or near a station, as well as urbanization or development in the area, can have lasting, though typically undocumented effects on measurements at a station. A fairly simple solution to these problems can be achieved by constraining any analysis of long-term climatic trends and patterns to stations included in the US Historical Climate Network (http://cdiac.esd.ornl.gov/epubs/ndp019/ndp019.html). The US HCN consists of data at selected stations that have been corrected for the effects of station moves and certain external influences specifically for the purpose of rendering each station dataset

appropriate for analysis of climatic variability and change. The relatively small number of stations included in the US HCN, however, may prove insufficient for some analyses. In these cases, it would be worthwhile to research station histories (including station moves and changes in the nearby environment) and make an attempt to correct for the effects of moves and external environmental changes.

Other Recommendations

If climate is to be monitored as a vital sign in the Greater Yellowstone Ecosystem/Bighorn Canyon Area, the most important investment the Vital Signs Network can make is to ensure the continuation of existing climate stations. The longer a station has been in existence, the more valuable it is for any attempts to analyze long-term climatic variability and change. It is essential that the Vital Signs network maintain an awareness of the status of weather and climate stations in the Greater Yellowstone Ecosystem/Bighorn Canyon area as well as connections with the individuals and institutions that maintain this infrastructure. This awareness may help prevent the unnecessary discontinuation of valuable weather stations.

While long-term weather stations are the most valuable in the network, temporary or portable weather stations can provide a significant contribution to our understanding of climate in the GYE. When maintained for a sufficient period, temporary weather stations can provide an indication of the relationship between conditions at long-term weather stations and conditions at the temporary station. This can inform climate modeling efforts and sometimes allow for the estimation of previous climatic conditions at the temporary site. It is, however, important to remember that any estimation of previous

conditions rests on the assumption that the relationship between climate at the temporary station and long-term station or stations has not changed significantly over time.

Finally, if the GYN chooses to monitor climate in the GYE/Bighorn Canyon area as a vital sign, it will be necessary to determine which aspects of climate are to be monitored. Though the majority of climate stations (excluding snow surveys) do collect certain core measurements (generally air temperature and precipitation), other types of measurements (such as snow depth, snow water equivalent, wind speed and direction, and relative humidity) are not available at all stations. If the network wishes to consistently monitor (and eventually analyze) parameters other than temperature and precipitation, it may be useful to install additional sensors at certain key sites.